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ABSTRACT

The Institut fur die Padagogik der Naturwissenschaften (IPN) is the research institute for science education, with a national function in the Federal Republic of Germany. The IPN consists of biology education, chemistry education, physics education, educational science, research methodology/statistics, and administration/general services departments. IPN history, research directions, institutional organization and boards, financing, interdisciplinary activities, research planning, and continuing institutional services are discussed. Areas of research according to a 3-year plan (1983-85) are also discussed. These include areas of general concern (such as health education and teacher training), areas of preliminary investigation (such as ecotechnology and science education), areas of major concentration (including curriculum development, and attitudes, values, and interests in science education), and areas of applied research. Also included are summaries of completed research projects, lists of IPN symposia and seminars, lists of IPN publications (in German unless otherwise noted) in biology, chemistry, physics, and science for handicapped children, and lists of IPN research reports and reports-in-brief. The latter contain information about the IPN and its scientific studies, summaries of extensive anthologies of reports, concepts, and reviews of science-related research. Lists of IPN board and staff members are also provided. (JN)

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Institut für die Pädagogik der Naturwissenschaften
an der Universität Kiel

IPN

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Institut für die Pädagogik der Naturwissenschaften
an der Universität Kiel

Information Booklet

3rd Edition 1983

11 IPN Report-in-Brief

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INSTITUT FÜR DIE PÄDAGOGIK DER NATURWISSENSCHAFTEN
AN DER UNIVERSITÄT KIEL

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AN DER UNIVERSITÄT KIEL

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Thorsten Kapune	Head of Administration and General Services
Helmut Mikelskis	Chairman of the IPN Staff's Standing Scientific Committee
Walter Westphal	Head of the Department of Physics Education

The information contained herein covers the period up to and including January 1983.

All publications issued between 1966 and 1978 are listed in Report-in-Brief No. 18 (180 p.); publications issued between 1978 and 1981 are contained in Report-in-Brief No. 24 (115 p.). The content of some publications is described. Both of these reports can be obtained free of charge from the Institute upon request.

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1. Survey

The Institute for Science Education (IPN) is the research institute in science education with a national function in the Federal Republic of Germany. Between 40 and 50 researchers work at the Institute (permanent staff). About the same number are technical, administrative and secretarial staff. In addition, approximately 200 teachers, scientists, specialists, and undergraduates from the field of research, administration, planning and economy cooperate with the IPN on a part-time basis.

The IPN consists of the following departments:

— Biology Education
— Chemistry Education
— Physics Education
— Educational Science
— Research Methodology and Statistics
— Administration and General Services

Research work is done according to "research areas" in which, normally, members from various departments are involved. At present, the main activities are:

— Basic research in science education
— Development and evaluation of science curricula
— Co-operation with those involved in the direct practice of education (with pupils, students, teachers, professors, etc.)
— Co-operation with those indirectly involved in education (educational planners, special consultants, lecturers in advanced teacher training, heads of seminars, curriculum committees)
— Advice on and the evaluation of external research projects
— Counselling experimental schools
— Advice on decision-making regarding educational planning and policy-making
— Qualifying staff of university and teacher training institutions for science education
— National and international exchange of information about research in science education
— Information and documentation within the Federal Republic of Germany
— Promotion of international co-operation, as regards science instruction, especially within Europe; co-operation with international institutions (UNESCO, OECD, Council of Europe, European Communities)
— Publication and co-publication of several journals

2. History

1964 On the initiative of Karl Hecht, the Study Group for Science Education within the German Association of Technical and Scientific Societies submits a "Memorandum on Founding an Institute for Science Education".

1966 Founding of the "Institut für die Pädagogik der Naturwissenschaften" (Institute for Science Education) at the University of Kiel. Karl Hecht becomes the first Director of the Institute. Establishment of a "Stiftung für die Pädagogik der Naturwissenschaften" (Foundation for Science Education) which supports the Institute. Initial financing through the "Stiftung Volkswagenwerk" (Volkswagen Foundation). Establishment of the departments of physics and chemistry education.

1969 Establishment of the departments of biology education and educational sciences.

1972 Karl Hecht retires. Karl Frey is elected Managing Director. Later on reelected for the period up to 1984. The Board of Trustees agrees upon the establishment of the Department of Research Methodology and Statistics.

1973 Termination of support from the Volkswagen Foundation. The Institute is now supported through subsidies provided by the Federal Government and the Land Schleswig-Holstein on the basis of a bilateral agreement.

1977 The financing of the Institute is altered: the Institute is included in the agreement on the promotion of research between the Federal Government and the German "Länder". It acquires the status of a research institute with a national function.

1980 The "Foundation for Science Education" is dissolved. The Institute becomes an institution of the Land Schleswig-Holstein. The national function and the financial status are not altered.

3. Research Directions

The main task of the IPN in its starting phase (1966 to 1970) was to develop curriculum materials for biology, chemistry and physics, with two aims: on the one hand, the Institute was to bring about the improvement of science teaching in schools at the grades 5 and 6 and, on the other, basic research was to be done on, and with the aid of, curriculum development. Researchers at the IPN tried to attain both aims simultaneously. Since curriculum research in the Federal Republic was still in its beginning stages, it would have taken years before the results of an extensively laid-out basic research program in curriculum construction would have led to the actual reform of science instruction.

The first projects ot the IPN with emphasis on research involved problems that had proven particularly significant for the design of instruction. The so-called affective presuppositions and results of learning processes, e.g. problems of motivation, attitudes and attitude changes, were investigated in this context; questions regarding the training of the capability to solve problems were dealt with, and models for curricular testing, application and evaluation were developed.

The taking up of such projects characterizes the end of the starting phase of the IPN. Since 1970/71 the IPN has studied the work of foreign institutes which pursue similar aims in order to be able to analyse the situation of research, development and implementation in the curricular sphere on an international level.

Thereby the following became evident:
Basic research in the educational field can only be carried out meaningfully when it is problem-oriented and, at the same time, model-oriented. Most of the research projects should include possible applications and technologies as task areas.

Research should satisfy medium and long-term planning as well as momentary demand, so as to prevent certain questions from being excluded completely from the research programme or worked on with means which have been developed especially for this purpose. The Institute directs its research to concrete problems, but it also aims for its findings to be applicable to future development and planning.

The IPN maintains contact with science education institutions at home and abroad, it operates an exchange with international institutions such as UNESCO, OECD, the European Communities, and the Council of Europe. The findings of international research can thus be taken into consideration and, at the same time, IPN achievements can be introduced to the professional world.

4. Institutional Organization and Boards

Education, except for vocational education, in the Federal Republic of Germany is under the autonomy of the Länder. The constitution (§ 91 b) provides for involvement of the Federal Government in research in education. The IPN's role has to be seen within this frame. Legally and administratively the IPN is a research institute of the Land Schleswig-Holstein. But its functions and tasks are national, yet respect the autonomy of the Länder. Fig. 1 shows the Federal Republic of Germany divided up into the separate Länder.

The Institute is affiliated with the University of Kiel but remains a legally and economically independent institution. The staff is made up of civil servants (permanent staff).

Since the IPN deals with the sciences, and sometimes also with technology as a field of education, in the concrete from of syllabi, curricula and the development of instruction, the rest of the Länder are also interested parties, as well as direct cooperative partners. As a result, the IPN also works with the individual Länder, depending on the project and field in question.

The institutional set-up of the IPN is determined by the constant co-operation with the following institutions:

— Administrative Board
— Advisory Board
— Federal Ministry of Education and Science
— Educational Ministry of Schleswig-Holstein

Contact with the Federal and State Commission for Educational Planning and Promotion of Research and occasional co-operation with the individual Länder influence work at the IPN.

This structure not only takes the legal situation in the Federal Republic of Germany into account, but also the subjects handled at the IPN: concrete subject matter, which falls under the jurisdiction of the Länder, and structural and planning problems pursued with the significant participation of the Federal Government.

A relatively large amount of effort is required to coordinate all these commitments and connections of the Institute. Making use of this situation, however, has proved to be effective. It guaran-

Fig. 1 The FEDERAL REPUBLIC OF GERMANY
The "Laender" and their respective capitals.

tees that the research work of the Institute is oriented to current problems and has a secure frame. The necessarily wide spectrum of external influence prevents solutions that are too simple, and introduces more diverse aspects into the work of the Institute.

Fig. 2 provides an overview of the boards and institutions which are linked with the IPN.

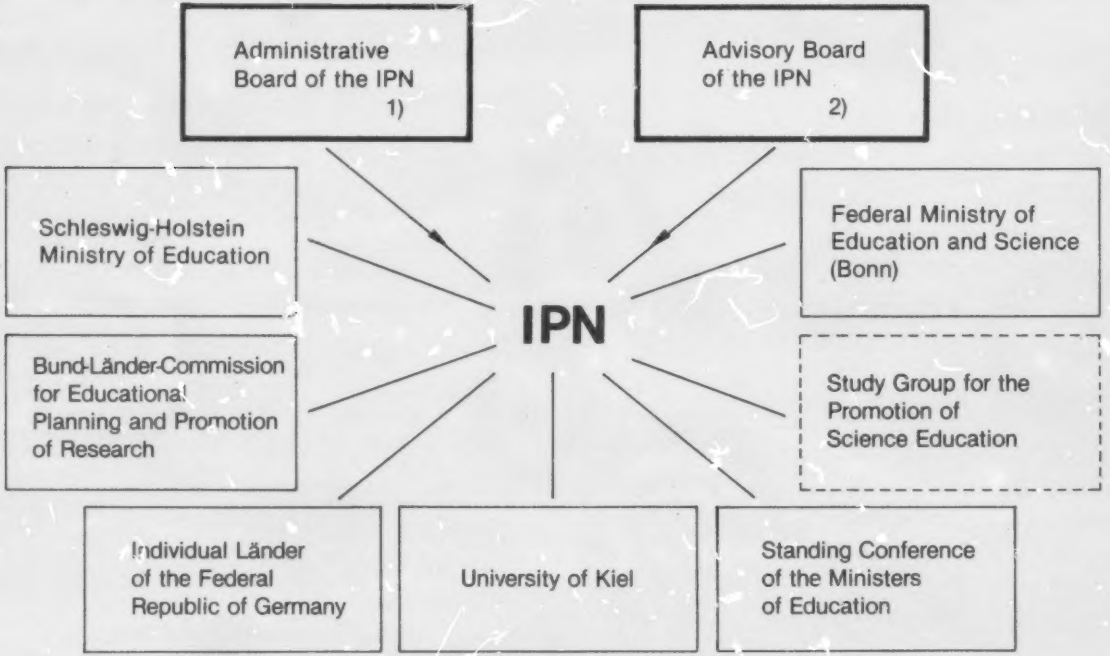
Administrative Board of the IPN 1)
Advisory Board of the IPN 2)
Schleswig-Holstein Ministry of Education
Federal Ministry of Education and Science (Bonn)
IPN
Bund-Länder-Commission for Educational Planning and Promotion of Research
Study Group for the Promotion of Science Education
Individual Länder of the Federal Republic of Germany
University of Kiel
Standing Conference of the Ministers of Education

Fig. 2: Institutional Set-Up of the IPN

1) The Administrative Board of the IPN sets the guidelines for the Institute's work.
2) The Advisory Board of the IPN has an advisory function in that it helps to determine the guidelines for the scientific work of the Institute.

The Administrative Board

The Administrative Board sets the guidelines for the Institute's work and consists of six members. The ex officio members are one representative each from the Ministry of Education in Schleswig-Holstein (chairman), the Federal Ministry of Education and Science, the University of Kiel and the chairman of the Advisory Board. In addition, the Advisory Board of the IPN elects two of its members as delegates for the Administrative Board.

The Advisory Board

The Advisory Board of the IPN has an advisory function in that it helps to determine the guidelines for the scientific work of the Institute. It is composed of fifteen members, namely, six representatives of the Länder, a representative of the Federal Ministry of Education and Science and eight scientific members. The representatives of the Federal Government and the Länder are delegated, the scientific members are elected.

The IPN Staff's Standing Scientific Committee

This Committee provides advice on scientific projects of the Institute and organizes a colloquium at which the researchers at the IPN describe their research areas. The Managing Director of the IPN hears the Committee on important scientific projects. The Committee consists of nine elected staff members of the Institute.

5. Financing

The IPN is permanently financed by the Federal Government (50 %) and the Land Schleswig-Holstein together with the other Länder (50 %). In addition, there are one to two projects of a limited duration. Personnel funds for 1983 amount to 5 million DM. The material costs amount to 1.5 million DM.

In order to help clarify the situation of the IPN, some general information about the financing of research institutes in the Federal Republic of Germany is necessary. A number of big research centres (mostly institutes for physics or technology, e.g. DESY) are predominantly financed by the Federal Government. The "Deutsche Forschungsgemeinschaft" (German Science Foundation), which gets its money from the Federal Government as well as from the Länder, finances projects of a limited duration. Then there are two notable groups of institutes which are *continuously* financed by the Federal Government and *all* the Länder:

1) Approximately 50 Max-Planck-Institutes. They are concerned mainly with basic research. Examples: Institut für Völkerrecht, Heidelberg; Astrophysik, München; Bildungsforschung, Berlin.

2) Approximately 45 institutes with national relevance. In comparison to the first group, their work is more of an applied and functional nature. This distinction, however, is not always very pronounced. Examples: Institut für Schiffs- und Tropenkrankheiten, Hamburg; Erdölforschung, Hannover; Zentralbibliothek der Medizin, Köln. Among these institutes there are 4 institutes dealing with the field of education, namely, Deutsches Institut für Fernstudien an der Universität Tübingen (DIFF); Deutsches Institut für Internationale Pädagogische Forschung (DIPF), Frankfurt; Pädagogische Arbeitsstelle des Deutschen Volkshochschulverbandes (PAS), Frankfurt am Main, and the IPN.

6. Interdisciplinary Approaches

Most research problems the IPN deals with demand competence from specialized branches of science: biology, chemistry, physics; in addition, it may become necessary to include curriculum theory, learning or developmental psychology, research statistics, history of the sciences, or epistemology.

The majority of researchers at the IPN specialize in one of the natural sciences and in one discipline from educational sciences, e.g. physics and cognitive psychology or chemistry and strategies of in-service teacher training. In addition, there are approximately ten specialists in sub-areas of the educational sciences (e.g. developmental psychology, innovation research) who have been working in the field of science education from five to ten years.

At the IPN, researchers with very different competencies cooperate in one of the — at present — 22 fields of work. Fig. 3 illustrates the structure on the basis of two examples. For purpose of organization and in order to develop and maintain their competence, the researchers belong to a department. The research work in the 22 fields of work is executed via interdepartmental working groups. There are also areas of research that are dealt with within only one department. Such working groups last for a duration of three to six years.

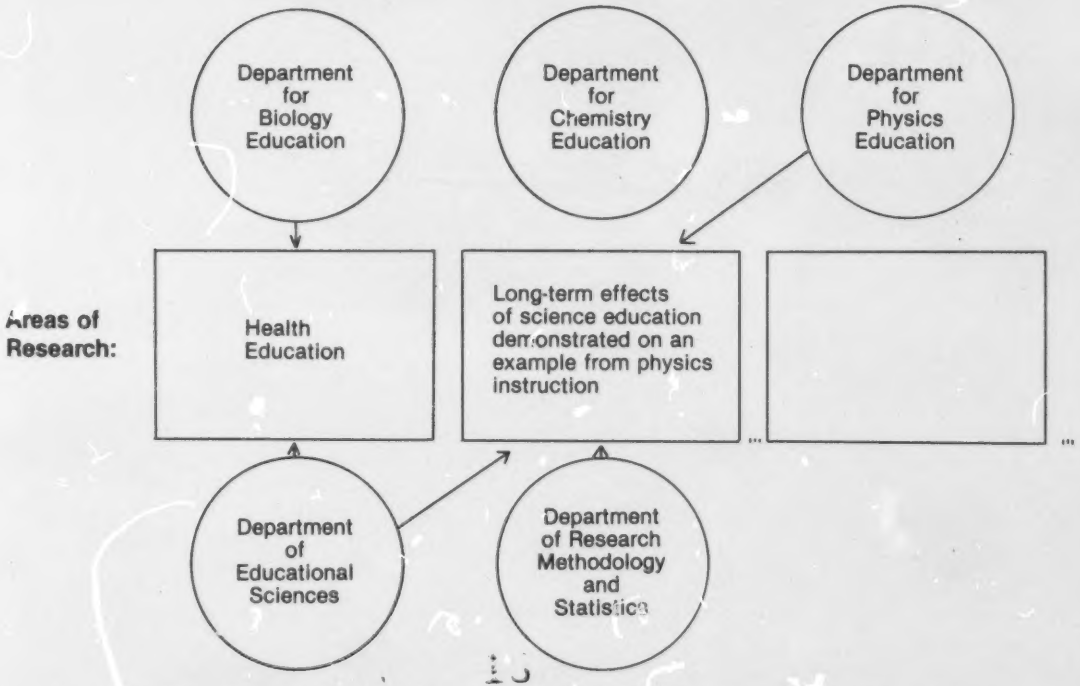
Department for Biology Education
Department for Chemistry Education
Department for Physics Education
Areas of Research:
Health Education
Long-term effects of science education demonstrated on an example from physics instruction
Department of Educational Sciences
Department of Research Methodology and Statistics

Fig. 3 Two Examples for the Interdisciplinary Approach to the Research Problems

7. Research Planning

Every three years the Institute prepares a research plan. It describes approximately twenty areas of research - at present, for the years 1983 to 1985. Preparation of the plan takes place in accordance with the principle of self-organization. Interactive self-organization regulates the internal/external relations of the Institute. This means that the Institute determines its own research plan. Within the framework of the statutes, the IPN is autonomous. The Institute does, however, take up interaction with external persons and institutions when planning research, e.g. with developmental institutes in other states, with teachers, often also with scientists from other fields of research. Many of the external persons with whom possible research needs are discussed are not scientists from natural science fields. This is where research planning at the Institute differs from the usual scientific planning.

The development of the 3-year plan (1983 to 1985) took place in three stages. At first new tasks were identified. Then fields of research from the previous 3-year plan were examined to determine whether they should be continued or how they might be modified. The third stage involved a description of future fields of research. Finally, the supervisory boards of the IPN studied the draft of the 3-year plan and made comments and recommendations.

A special publication deals with the research planning of the IPN. It describes the conceptional foundations of research planning and experiences with it (FREY, Karl: Forschungsplanung am IPN (Research Planning at the IPN). IPN Report-in-Brief 20. 93 p., 1980. It can be obtained free of charge from the IPN).

8. Continuing Institutional Services

This is a selection of the activities with which the IPN deals, especially as it is a national institution. The activities serve to disseminate domestic and foreign research work in the field of science education. They include:

— Observation and analysis of important international innovations and their publication in the Federal Republic of Germany as well as publication of the results of German research abroad, but especially in Europe
— Organization of symposia on central topics
— Organization of seminars for the different fields
— Supervision of participants from the Federal Republic of Germany at the International Pupil Olympics in Physics and Chemistry

The IPN has many other service functions. They will be mentioned under the individual areas of activity.

9. Areas of Reseach According to the Three-Year Plan 1983 - 1985

The Three-Year Plan describes the focal points of work done at the IPN (cf. chapter 7). The areas of research are arranged as follows:

— areas of general concern
— areas of preliminary investigation
— areas of major concentration
— areas of applied research

Areas of General Concern

This category includes tasks which are important preconditions for effective work on the part of the Institute but which — due to a lack of sufficient work capacity — cannot be treated as areas of priority. The work expenditure on and intensity of the areas of general concern are characterized by separate studies, workshops, collection of information, domestic and foreign contacts and documentations.

Area of General Concern 1: General Science on the Elementary Level

Systematically designed occupation with nature and technology takes place in the elementary schools as part of education on general science, local history and geography. Its span extends from the child's first experiences to scientifically oriented occupation with problems.

In cooperation with external colleagues, the development in general science education in the Federal Republic of Germany as well as science in primary education is observed, documented (to the extent that this is possible) and made available to interested parties. For several topics advice is given on research and developmental activities abroad. Such activities are organized and suggested.

Area of General Concern 2: Health Education

The focal point of this field of work is the search for possibilities to improve the information of the people about health-related be-

haviour. Studies and the development of conceptions in various sub-areas are planned.

From the many topics for research and developmental work, the following four are dealt with at the beginning: nutrition; use of medication, stimulants and drugs; biology instruction and the handicapped; health education within the family and as a topic of biology instruction.

Area of General Concern 3: Teacher Training

This field deals with pre- and in-service training of science teachers. Research and development related to the field of teacher training at home and abroad are observed and analyzed, documented and disseminated with the goal of supporting self-sufficient, scientific and continued teaching and learning on the part of the teachers.

At present, the activities concentrate on in-service teacher-training.

The priorities are:
— the role of the systematic structure within subject matter
— the science teacher's insight into technology
— regional in-service training of teachers
— evaluation of in-service teacher training

Area of General Concern 4: Conditions for Innovation Processes in the Area of Science and Technology Education

The conditions for innovation and further development of the field of science and technology education and the innovational capability of the schools are the object of research work. Knowledge about innovations that is significant for the improvement of science/technology education, that can be used accordingly or be adapted is collected from the literature and analyzed and, in part, produced.

Area of General Concern 5: Methods of Empirical Research and of the Evaluation of Data concerning Science Education

The instruments of curriculum evaluation and of instructional research are the focal point here. New developments outside the Institute are studied and made applicable to the empirical studies

that are carried out at the IPN. Specific methodical approaches for data evaluation are further developed, corresponding computer programs are adapted and made available.

Area of General Concern 6: Science Education in the Context of the North-South Dialogue

The main idea is to work out a conception for international development as regards science education in developing countries. It seeks cooperation and dialogue and supplies orientations for self-sufficient development. Visits of experts are organized. Seminars are planned and conducted.

Areas of Preliminary Investigation

Under this rubric are important fields whose exact definition of goals, forms of treatment, and possibilities of realization have not yet been completely clarified. For this reason, a limited amount of work is invested in these areas for a few months. In the event that a positive decision is reached at the end of the preliminary period, the project in question is transferred to an area of major concentration.

Area of Preliminary Investigation 1: eco-techno-logy and science education

Approaches to "eco-techno-logy" are to be elaborated and further developed for teaching. Furthermore, it is of interest to study what preconditions make it possible for the individual to orient oneself in complex, dynamic systems and find suitable solutions and how responsible and democratic decision-making processes can be promoted.

Area of Major Concentration 1: Information/Documentation/ Cooperation (IDK)

The work is both product- and process-oriented: documentations and analyses of materials (syllabuses, curricula, textbooks etc.) from the field of science in school are prepared and published. Informal and formal activities (ad hoc working groups, seminars) as well as other forms of cooperative work (participation in advisory boards and cooperation in committees which care for individual documentation projects, assistance in and gain of the cooperation of institutions which do work in the field of documentation) complement these publications. Preliminary work on a report concerning the situation of science/technology education in the Federal Republic of Germany has begun.

Area of Major Concentration 2: Studies on Relationships to Nature and their Significance for Educational Processes

The studies deal with historical and cultural conceptions of nature that have become significant for education in the technological and scientific disciplines. They also deal with those approaches to nature that are not at all or only slightly significant for scientific teaching processes. This includes the conceptions of nature prevalent in cultural groups of the Third World. The studies deal with changes in the comprehension of nature in current scientific disciplines and relate to further trends in the philosophical development of the topic of nature. They contain implications for perceptual psychology. The studies have consequences for those segments of teaching processes which are concerned with selecting natural objects for focus, forms of perceiving nature and the presentation of methods for dealing with objects.

Area of Major Concentration 3: The Organization and Conveyance of Scientific Knowledge — Investigations of their Interrelationship on the Basis of the History and Sociology of Science

It is examined whether certain forms of knowledge require specific curricular approaches. It is also of interest to learn the effect of the organization of the learning content on the attitude toward the acquired knowledge. Both aspects are part of the pervading educational question concerning the relationship of content and method. A contribution starting from the sociology of knowledge is in the process of preparation. The social scientific approach is

supplemented by one from the aspect of the history of science. Here it is asked, which leading conceptions directed the work of physicists and how these were reflected in the theories.

Area of Major Concentration 4: Curriculum Development in Science Education

This field of work combines the various developmental activities. In addition, this field of work should deal with problems that are common to all developmental activities. There are five components: curriculum development for biology, chemistry, computer science (within the framework of science education), physics, and the development of interdisciplinary curricula.

Area of Major Concentration 5: Educational Utilization of Natural Resources on School Grounds and in Communities

The development of behaviour oriented towards caring for the environment is increasingly mentioned as an essential goal of instruction today. The promotion of direct, active confrontation with nature is allotted the utmost importance. It is examined which possibilities the in-school and out-of-school grounds have for learning about nature and discovering the environment and how these possibilities can be expanded and utilized more effectively.

Area of Major Concentration 6: Long-Term Effects of Science Education Using Physics as an Example

An attempt is made to gather empirically assured information about the long-term effects of science education using physics as an example. On the basis of a curricular framework for physics instruction, an assessment procedure was developed which makes it possible to test hypotheses concerning the relationship between educational input and the present educational level of a person in the field of physics.

Area of Major Concentration 7: Labour, Technology and Vocation and their Relationship to General Education

The relationship of labour, technology and vocation to general education and vocational training is understood here as an important starting point for reflection about scientific and techno-

logical instruction. The analysis of research findings as regards the relationship of nature/technostructure/work organization and qualification, supplemented by empirical research into choice of vocation and supported by accompanying trial runs of instruction, is meant to enrich the existing conceptions of general scientific education and alter them in a lasting manner.

Area of Major Concentration 8: Generative Framework for Physics Education

The development of a research program for physics education is attempted by means of a theory of activity from an interdisciplinary approach. This theory is elaborated in subsequent steps to general educational and subject-specific sub-theories that should make a theory-guided procedure possible. The theoretical studies must prove their worth in the development of teaching materials.

Area of Major Concentration 9: Values, Attitudes and Interests and the Process of Science Education

Topics are: 1) The attitudes and interests of students in the field of science and technology and the way they change in the course of the school years. An attempt is made to identify the causes that are decisive for the observable changes. 2) The conditional factors for generating environmental consciousness are analyzed.

Area of Major Concentration 10: Structure and Modification of Knowledge and Problem-Solving Structures

This area deals with problems such as: how can one establish a link to pre-existing knowledge structures while teaching scientific subject matter? What modifications, with or without the influence of instruction, are cognitive structures subjected to? How do problem-solving processes interact with the knowledge-structure and how can they be furthered via instruction? There are plans to conduct various empirical studies using a particular cognitive-theoretical perspective.

Area of Major Concentration 11: Computer Science and Science Education

The work deals both with the inclusion of subject matter from computer science in various subjects and support of teaching computer science. Related work is done in computer science education concerning the development of teaching materials, aids for teachers and co-operation in educational policy decisions.

Areas of Applied Research

It has proved to be meaningful and, in many cases, practicable to combine and apply personal competencies or instrumentalized knowledge from the areas of Major Concentration and of General Concern in such a way that additional or new areas of research are formed. This occurs, for instance, when consultation concerning projects outside the IPN takes place.

The areas of General Concern and the Areas of Applied Research are something of an accompanying and supporting surrounding field for the Areas of Major Concentration. This relationship, however, should not be seen too narrowly from a functional viewpoint.

Area of Applied Research 1: Methods in Science and Technology Education

In various areas of research at the IPN information about instruction methods is processed into presentations whose purpose is to be of practical use for instruction. The presentations connect various drafts for practical action or planning for instruction with theoretical justifications to form unified conceptions. They are to be used both in instruction and teacher in-service training. Topics are: communicative learning by means of offering teaching materials; methodological preconditions for science/technology teaching; the project method; the experiment in science instruction.

Area of Applied Research 2: Application of the Curriculum Conference to the Area of Science Education

An approach to curriculum development via commissions, committees and ad-hoc groups was developed under the title of "cur-

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riculum conference". Processing the wealth of science information plays a special role.

An attempt is made to improve this approach for different situations to which it could be applied (federal commissions, teacher groups, teams of authors and student-teacher groups).

Area of Applied Research 3: Ecology and Environmental Education

Now that a didactic concept for ecology and environmental education has been developed, work in the coming years will focus on utilizing the developed resources and competence. To be continued are current documentations, empirical investigations on environmental education in the Federal Republic of Germany, the development of teaching material, cooperation and guidance in the field of direct and indirect practice of education in the Federal Republic of Germany as well as collaboration with international committees concerned with environmental education.

Area of Applied Research 4: Interstate Cooperation on Syllabi

The aim of the studies which fall under this heading is to encourage and organize an exchange of information between the Länder, while respecting the autonomy of each, regarding the syllabus sector as well as to include new subject-specific developments in the syllabus work as further stimulus.

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10. Completed Projects

Survey:

- Analysis of Science Curricula
- The IPN Chemistry Curriculum for the Grades 5/6
- The IPN Physics Curriculum for the Grades 5/6
- Study of the Effectiveness of the IPN Physics Curriculum for Grades 5/6
- Statistical Methods in Socio-Psychological Studies
- Basic Research on Test Theory
- Algorithms in Problem-Solving
- Science Instruction in „Gesamtschulen" (Comprehensive Schools)
- Drafting of Film Material for Science Instruction
- Overall Structure of Biology Instruction
- Attitude and Change of Attitude in the Field of Science and Technology
- Cognitive Operations and Learning Processes as a Basis for Student-Oriented Instruction
- Instruction Units from the Field of Work "The History of the Sciences in Science Instruction"
- Generative Framework for Chemistry Education
- Basic Science Education and Electives in the Field of Science at Secondary Level I
- Concepts and Terms in Science and Instruction

Analysis of Science Curricula

In the field of curriculum analysis a method was developed and tested which can be applied to quantitative and systematic analyses of school science curricula.

This method has found a number of applications both inside and outside of the IPN. In addition to the analysis of curriculum materials, its usefulness for teacher education should be mentioned.

The analytical scheme appeared in a bilingual edition (German/English) published by the Beltz-Verlag, Weinheim: HÄUSSLER/PITTMAN: System zur Analyse naturwissenschaftlicher Curricula/A Curriculum Material Analysis System for Science, 1973.

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The IPN Chemistry Curriculum for Grades 5 and 6

The curriculum for grades 5 and 6 demonstrates one way of introducing students of the appropriate age group to chemistry. For the development of the curriculum, an approach was chosen which, while determined by chemistry, still brings in the related fields of biology, physics and technology. In all, eight instruction modules were developed, tested frequently in class, and published.

The titles of these modules are:

We purify water and obtain salt; We investigate the kindling of fire, the smouldering and the burning of fire; While building a hut, we become acquainted with the properties of matter and how matter is converted, and learn about fire fighting; We investigate lime and cement; We preserve food and study fermentation; We learn how to produce metals, and learn what they are used for; We dissolve, crystallize, extract and precipitate; We produce electrochemical cells and using them we study the conversion of matter and energy.

The materials were published by the Ernst Klett Verlag in Stuttgart during the period from 1971 to 1974 and are distributed by the IPN.

The IPN Physics Curriculum for Grades 5 and 6

The instruction units for the grades 5 and 6 are a part of the IPN Physics Curriculum for grades 5 to 10. A new version has been developed for seven of the units as a consequence of test results in classrooms in almost all Länder of the Federal Republic of Germany. The units deal with the following subjects: the electric circuit; work and energy; heat expansion, temperature measurement, heat radiation; length, time, velocity; magnetism; light and shadow; forces.

The printed material was published by the Ernst Klett Verlag. Leybold-Heraeus, a teaching aids company, supplies the necessary apparatus.

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Study of the Effectiveness of the IPN Physics Curriculum for Grades 5/6

The aim of this quantitative evaluation was to discover the extent to which the goals of the IPN Physics Curriculum for grades 5 and 6, stated in an introductory booklet (1970) had been attained, and the effectiveness of the curriculum material. The effects of the curriculum in areas outside the classroom were also investigated, e.g. among curriculum development groups, textbook authors, and syllabus commissions.

For this investigation, data from 1970 to 1974 were used. They stem from reports provided by teachers, reports of visits to schools, written theses on the use of the curriculum, and interviews and questionnaires designed to analyze the effects of the curriculum on students and teachers. The results are published in: DUIT, R., RIQUARTS, K., WESTPHAL, W.: Wirkungen eines Curriculum. Eine Studie über die Verwendung des IPN-Curriculum in der Schulpraxis, in der Lehrplanarbeit und anderen Bereichen. Beltz-Verlag, Weinheim 1976 (Effects of a Curriculum — A Study of the Utilization of the IPN Curriculum in Actual School Practice, in Syllabus Work and other Areas).

Statistical Methods in Socio-Psychological Studies

This project dealt with the application of theoretical probability models to social psychology. The models were based on such concepts as "aggressiveness", "attitudes" and "catharsis". (As used in psychology, catharsis generally means the elimination of aggression, for instance by acting it out.) The results of the project might also be relevant for questions from the social and physical sciences. The results appeared in KEMPF, W.: Probabilistische Modelle in der Sozialpsychologie. Huber-Verlag, Bern 1974 (Probabilistic Models in Social Psychology).

Basic Research on Test Theory

The project aimed at the development of a "dynamic" test theory which broadens the differential psychological analysis of individual differences among people with respect to the dynamic aspect of dependence of behaviour on previous behaviour. Learning and

individual differences can be studied together advantageously here. To this end, a test model was developed and published, and is now used at several research institutes. KEMPF, W.F., HAMPAPA, P., MACH, G.: Conditional Maximum Likelihood Estimation for a Dynamic Test Model. IPN-Arbeitsberichte 13, Kiel: IPN, 1975 — KEMPF, W.F., NIEHUSEN, B., MACH, G.: Logistische Testmodelle mit additiven Nebenbedingungen. IPN-Arbeitsberichte 22, Kiel: IPN, 1976. (Logistic Test Models with Additive Secondary Conditions).

Algorithms in Problem-Solving

The goal of this project was to discover the heuristic search strategies according to which people construct algorithms in the process of problem-solving. The results are of primary significance for science instruction, insofar as the project is oriented toward problem-solving. They are published in: FILLBRANDT, H.H.: Gesetzmöglichkeiten der Entstehung von Operatoren in Lernsystemen. Dissertation Kiel, 1975.

Science Instruction in "Gesamtschulen" (Comprehensive Schools)

Within the framework of the scientific guidance of the Gesamtschule experiments in Schleswig-Holstein, the project group on science education at the Gesamtschule of Neumünster (set up by the Ministry of Education) developed and tested a model of differentiation for science instruction in grades 5 and 6. The project was intended as a contribution to the comparative study of the various types of schools.

The IPN, which was not active in the preliminary phases of the project, took over the further empirical testing and evaluation of the experiment. Hereby it became apparent that the Neumünster model cannot, as had been intended, be applied to all Schleswig-Holstein Gesamtschulen.

The IPN then drew up various models and began the urgently needed investigations in view of the original and ambitious goal of the project (inter-system comparison, i.e. comparison among the various types of schools or educational systems of the Länder).

The models and investigations were relatively costly and since their implementation was not adequately financed, the IPN recommended that the project be discontinued.

Drafting of Film Material for Science Instruction

The goal of this project was the development of audiovisual media, primarily films, as a task in connection with the curriculum material units, and not, as is usually the case, independent of this activity. Five films and a series of slides were developed as integral parts of the teaching unit "Problems of Water Pollution" for grades 8 to 10. This was done simultaneously with the development of the other teacher and student materials of this unit. The instruction unit joins the subjects of biology and social studies in the area of environmental education.

The Institut für Film und Bild in Wissenschaft und Unterricht (FWU, the Institute for Audiovisual Material in Science and Instruction) in Munich produced most of the films in collaboration with the IPN.

The themes of the films and slides: "Belastetes Wasser" (Polluted Water), "Wasser und die Gemeinde" (Water and the Community), "Lebewesen in Fließgewässern" (Living Organisms in Flowing Water), "Fangmethoden in Fließgewässern" (Methods of Capture in Flowing Water), "Das Mikroskop" (The Microscope).

Overall Structures of Biology Teaching

This field of work deals with the question: according to which pervading principles is a restructuring of the content of biology education possible and meaningful? The question arose out of experiences with the development of a biology curriculum at the Institute.

At the 6th IPN Symposium the IPN suggested three approaches to structuring:

— the ecological structuring approach
— the system-theoretical structuring approach
— the human-oriented structuring approach

A report was published by the Aulis Publishing Company, Köln: KATTMANN, U., ISENSEE, W. (Eds.): Strukturen des Biologieunterrichts. 1975 (Structures of Biology Teaching).

The ecological structuring approach was pursued further as part of the field of work "environmental education":

EULEFELD, G., WEIDEMANN, G.: Ökologie und Umwelterziehung in Schulunterricht und Studium (Ecology and Environmental Education in School and at Universities). In: MÜLLER, P. (Ed.): Verhandlungen der Gesellschaft für Ökologie. Den Haag: Junk, 1977. EULEFELD, G., FREY, K., HAFT, H. et al.: Ökologie und Umwelterziehung. Ein didaktisches Konzept. Stuttgart, Berlin, Köln, Mainz: Kohlhammer 1981. (Ecology and Environmental Education. A didactial conception).

The systems-theoretical structuring approach was used to develop a paradigmatic instruction unit:
BAYRHUBER, H., SCHAEFER, G.: Kybernetische Biologie. Unterrichtseinheit für die Sekundarstufe II. Köln: Aulis, 1978 (Cybernetic Biology. Instruction Unit for Secondary Level II), whereby its applicability with respect to arranging biological themes according to certain aspects was tested along with structuring a subarea at Secondary Level II.

The human-oriented approach was extensively justified and concretized for Secondary Level I. This approach can be used as an instrument on various levels of the curriculum process, e.g. for syllabus work, school-related curriculum development or for the direct planning of instruction. KATTMANN, U.: Bezugspunkt Mensch. Grundlegung einer humanzentrierten Strukturierung des Biologieunterrichts. Köln: Aulis, 1977 (Reference Point: Man. A Basis for a Human-Oriented Structuring of Biology Instruction).

Attitude and Change of Attitude in the Field of Science and Technology

A socially oriented determination of learning objectives, the empirically founded conception of teaching methods and the development of evaluation procedures that are convincing from the view of psychometrics were the main goals of this area of research which was dedicated to dealing with the so often neglected sphere of science education which directly influences the for-

mation and modification of pupils' attitudes toward scientific and technological objects.

Four groups of teaching measures were derived for an encompassing teaching experiment on the basis of social [illegible]logical and learning psychological theories. As part of science instruction they were meant to enable the pupil to take a critically reflective, environmentally conscious stand. They had to consider various points of view on questions concerning energy sources. The four groups of measures

— "Introduction of a Role Model - Learning via Structure Grid"
— "Activating by Alarming"
— "Stabilization of Attitudes with Respect to Manipulation of Opinions"
— "Group Instruction on the Basis of Sociometric Analyses"

were merged completely in the sense of a variance analytical design and tested within the framework of an instruction unit developed for the 9th and 10th grades. It was titled "Nuclear Power Plants - Dream or Nightmare?"

A new kind of situation test was developed on the basis of the test model of RASCH in order to comprehend multidimensional attitudes which correspond to the formulated conception of a critically reflected attitude. It makes it possible to register knowledge-, evaluation- and action-related pupil dispositions and it was used to evaluate instruction, particularly the various developed instruction measures.

The theoretical foundations, the procedure and the results of the classroom experiment — which is also a psychological contribution toward environmental education — were disseminated and adapted for use. Besides scientific publications, teaching and evaluation materials, and a practice-related catalogue of hints were prepared. Suggestions for the furtherance of critically reflected attitudes by means of science instruction were developed for the teacher in book form.

HOFFMANN, L., KATTMANN, U., LUCHT, H., SPADA, H.: Materialien zum Unterrichtsversuch "Kernkraftwerke in der Einstellung von Jugendlichen". IPN-Arbeitsbericht 15. Kiel: IPN, 1975 (Material for the Classroom Experiment "Students' Attitudes Toward Nuclear Power Plants").

SPADA, H., HOFFMANN, L., LUCHT-WRAGGE, H.: Students' Attitudes Toward Nuclar Power Plants — A Classroom Experiment in the Field of Environmental Psychology. Studies in Educational Evaluation 1977, Vol. 2, 2, pp. 109-128.

SPADA, H., LUCHT-WRAAGE, H.: A paper-and-pencil situation test to assess attitudes: an analysis of reactions to open-end items based on the model of RASCH. In: KAMP, L.J.Th. VAN DER (Ed.), LANGERAK, W.F. (Ed.), DE GRUIJTER, D.N.M. (Ed.): Psychometrics for educational debates. New York: John Wiley & Sons Ltd., 1980, pp. 277- 289.

Cognitive Operations and Learning Processes as a Basis for Student-Oriented Instruction

The preconditions of learning and thinking on the part of students for various subject areas (from physics, but also interdisciplinary) were studied with the aim of discovering how thought processes can be modified through instruction and how optimal problem-solving strategies appropriate for a particular age group can be developed. The result was procedures for formulating learning objectives and selecting learning steps — both are necessary for the construction of instruction. For the evaluation of instruction there resulted new possibilities for constructing learning objective-oriented tests under the consideration of the thinking and learning preconditions of the students.

In the course of this work - always with a view to questions of the conception and evaluation of science instruction:

— the beginning of a theory of structural, algorithmic learning was formulated;
— computerized algorithms for the analysis of the thinking and learning processes of students were developed;
— empirical analyses were conducted concerning the learning and thinking processes of students when solving tasks from the area of mechanics and when applying functional relationships in the natural sciences; the analyses dealt with subject-specific, psychological and educational aspects;
— evaluation procedures were conceived and methods for the preparation of tests which are oriented to learning objectives were developed further;

— the results of studies were disseminated by various means in the sense of a scientific exchange of information but also in the form of in-service teacher training (among other things, at IPN seminars and symposia).

Publications on this topic:

SPADA, H., HÄUSSLER, P., HEYNER, W.: Denkoperationen und Lernprozesse als Grundlage für lernerorientierten Unterricht. Versuchsplanung und erste Ergebnisse. IPN-Arbeitsbericht 5. Kiel: IPN, 1973 (Cognitive Operations and Learning Processes as a Basis for Learner-Oriented Instruction).
SPADA, H.: Modelle des Denkens und Lernens. Bern: Huber, 1976 (Models of Thinking and Learning).
SPADA, H., KEMPF, W.F. (Eds.): Structural Models of Thinking and Learning. Proceedings of IPN Symposium 7. Bern: Huber, 1977.

Instruction Units from the Field of Work "The History of the Sciences in Science Instruction".

These instruction units deal with science topics and, at the same time, provide a teaching-learning method based on them. They can be directly applied to instruction. Three of the instruction units are developed in Toronto, Canada, under the title "Studies in Scientific Enquiry" by the Ontario Institute for Studies in Education. They are translated at the IPN, tested in the classroom and rearranged - sometimes drastically - on the basis of the results of the trial runs in the classroom to suit the "gymnasiale Oberstufe" (upper level of Gymnasium).

The most important developmental stages of one research area each are indicated in the units (see below) - on the basis of a selection of original research reports. The didactic concept of the units intends that the students deal on their own with the process of generating scientific knowledge by means of the systematic analysis of the research texts. In order for them to do this, questions are pre-formulated.

The analysis of the research reports is aimed particularly at understanding the mutual dependency between theory and measuring data, whereby special importance is placed on the pluralism of theories as a motivating force behind the development of science.

The instruction materials are compiled under the heading "Fallstudien zur Wissenschaftsgeschichte" (Case Studies on History of Science) and deal with the following topics:

— "Die Tänze der Bienen" (The dance of the bee) - with a presentation of the controversy between O. Frisch and Wenner/Johnson over the problem of the bee's language via dance.
— "Die Suche nach dem missing link" (The search for the missing link) - with a presentation of the conflict between different paleontological theories of human phylogenesis.
— „Die Brechung des Lichts" (Refraction of light) - with a presentation of the development of theories in this field beginning with the ancient theory of the beam of light up to the 17th century.
— "Naturstoffe, Kunststoffe und das Makromolekülkonzept" (Natural Substances, Artifical Substances and the Concept of the Macromolecules). The development of Staudinger's concept of the macromolecule is presented. The documents stem from 1860 and reach into the more recent past. They illustrate the relationship of scientists to their subject, their colleagues, industrial production and political events.

The teaching units are to be published.

Generative Framework for Chemistry Education

This field of work ended in 1982 with an elaboration of the topic. The generative framework was applied to various working contexts and thereby proved its usefulness.

A series of studies were able to be connected in a productive way by this framework:

— studies on a qualitative concept of nature (now part of the area of research "Studies on Relationships to Nature and their Significance for Educational Processes"),
— the technical components of chemistry instruction were evolved especially in the course of developing material for an in-service teacher training project which took place in Cologne and dealt with the production of sulfuric acid,

— the symbolic conceptual component of this area of research links the studies to the clarification of terminology and to the everyday conceptions of children.

The developed generative framework is also of further service for research planning for chemistry education at the IPN.

Basic Science Education and Electives in the Field of Science at Secondary Level I

It was the aim of this field of work to develop a curriculum for the science electives at the "Gesamtschulen" (comprehensive schools) in the Land Nordrhein-Westfalen, to make suggestions for planning and carrying out instruction, to develop a concept for the delineation of the contents of electives and required courses and to re-examine the extent to which an integration or coordination of the individual subjects biology, chemistry and physics would be possible.

The studies were conducted within a model experiment "Naturwissenschaften im Wahlpflichtbereich" (The Sciences and Electives). Besides close co-operation with the Educational Ministry of Nordrhein-Westfalen, an exchange of experiences was organized between the Länder.

Here are some of the results:

a) The draft of the curricula for electives in science instructions at the comprehensive schools of Nordrhein-Westfalen.

b) A survey of students' interests for science education from the field of electives.

c) Collection of material and suggestions for teaching the following topics: "Das Getreidefeld" (The Cornfield), "Unsere Haut" (Our Skin), "Unser Kreislauf" (Our Circulation System), "Integrierte Schädlingsbekämpfung" (Integrated Pest Control), "Wetterkunde" (Meteorology), "Chronische Gesundheitsgefährdung" (Chronic Danges to Health and How to Avoid Them), "Parasitismus" (Parasitism), "Hilf Dir selbst und anderen. Biologie der Erkrankungen mit Hinweisen für die Behandlung durch Laien" (Help Yourself and Others. The Biology of Diseases with Hints for their Treatment by Laymen). — The publication of the material will start in 1983.

Concepts and Terms in Science and Instruction

The following studies were brought to some sort of a conclusion:

1. Analyses Concerning the Term "Amount of Substance"

It was discovered that the term "amount of substance" stems from the field of thought concerned with continuum and that it hampers gaining insight into subject matter in the discontinuum sphere. It was shown that, in thought centering around the discontinuum, the term "amount of substance" should be replaced by the term "number (of a portion)" and that this term not only leads to accurate comprehension but also, in conjunction with its use in quantity calculus, to statements of laws which are then easier to formulate as well as understand. Publication of the results led to an extensive scientific and didactic discussion as well as to the formation of a working committee "Number" at the Deutsches Institut für Normung (DIN) (German Institute of Standardization).

Weninger, J., Anzahl und Stoffmenge. In: Der Physikunterricht 15, 1981/4, pp. 41 - 54. (Number and Amount of Substance).

Weninger, J., Kritisches zur Vornorm DIN 32 629 "Stoffportion; Begriff, Kennzeichnung". In: Der mathematische und naturwissenschaftliche Unterricht 34, 1981, pp. 391 - 395. (Critique concerning Preliminary Norm DIN 32 629 "Portion of Substance; Concept, Characterization")

2. Quantity Calculus and Empirical Science

At first it was decided that quantity calculus is a method which can be used to comprehend and describe natural and technical phenomena with considerable advantage, but that not well-founded use of quantity calculus leads to comprehension difficulties. For this reason it was also decided what one really does when one uses quantity calculus which led to the understanding that, besides the (syntactic) application of quantity calculus, the (semantic) physical interpretation should not be neglected. Thereby important educational and subject-specific insights were gained that hopefully will contribute towards a better understanding of

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natural processes and the reduction of the justified rejection on the part of the students of the (up to now) kind of the mathematization of science instruction. A book is planned for 1983.

3. Thermodynamics

The concepts "boiling", "evaporation", "vaporization" were studied critically and re-defined on the basis of the consistent application of discontinuum thinking. This led to a better understanding of these concepts and it is a preparation for clarifying the important problem of what solutions are and where they belong within the system of terms. A publication is forthcoming in 1983.

11. IPN-Symposia

Interdisciplinary and Inter-state Exchange of Information.

One of the interstate tasks of the IPN consists in disseminating the findings of foreign studies in the field of science education to the appropriate German specialists, as well as publicizing the findings of such studies within the Federal Republic of Germany.

Common to all the symposia is the fact that they do not only deal with one particular science subject but go beyond the boundaries of teaching individual science subjects and include basic questions of science instruction.

The language used at the IPN symposia is German unless otherwise stated.

The series of IPN symposia:

1. Research and Development of Science Curricula (in English)
   Chairmanship: Prof. Dr. K. Hecht
   Date: October 14 - 17, 1970.
2. Kognitionspsychologie und naturwissenschaftlicher Unterricht (Cognitive Processes and Science Instruction)
   Chairmanship: Prof. Dr. K. Frey
   Date: March 13 - 15, 1972
3. IPN Symposium/UNESCO Seminar: The Implementation of Curricula in Science Education with Special Regard to the Teaching of Physics (in English)
   Chairmanship: Prof. Dr. K. Hecht
   Date: March 16 - 18, 1972
4. Integriertes Curriculum Naturwissenschaft — Theoretische Grundlagen und Ansätze (Integrated Science Curriculum - Theoretical Foundation and Approaches)
   Chairmanship: Prof. Dr. K. Frey
   Date: April 10 - 13, 1973.
5. Integriertes Curriculum Naturwissenschaft in der Sekundarstufe I — Projekte und Innovationsstrategien (Integrated Science Curriculum for the Grades 5 to 10 — Projects and Strategies of Innovation)
   Chairmanship: Prof. Dr. K. Frey
   Date: November 19 - December 1, 1973
6. Strukturen des Biologieunterrichts (Structures of Biology Instruction)
   Chairmanship: OStR Dr. U. Kattmann/OStR W. Isensee
   Date: September 23 - 26, 1974.

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7. Formalized Theories of Thinking and Learning and Their Implications for Science Instruction (in English)
   Chairmanship: Dr. W. F. Kempf/Dr. H. Spada
   Date: September 10 - 12, 1975.

8. IPN Symposium/Council of Europe Workshop: Research in Science Education in Europe - Improvement of Research Activities and Results (in English)
   Chairmanship, IPN: Prof. Dr. K. Frey, Dr. K. Blänsdorf, Dr. Th. Kapune, Prof. Dr. G. Schaefer
   Chairmanship, Council of Europe: Maurice Tyerman, Strasbourg.
   Date: October 27 - 29, 1976, in Malente

9. Verfahren für die Evaluation von Lehrerfortbildung (Procedures for the Evaluation of In-Service Teacher Training)
   Chairmanship: Prof. Dr. K. Frey
   Date: December 4 - 8, 1979.

10. Bildender Umgang mit Natur (Instructive Relations with Nature)
    Date: September 30 - October 3, 1980, in Dortmund.

11. Lehrerausbildung - Sachunterricht (Teacher Training for General Science)
    Chairmanship: Dr. R. Lauterbach, Diplom-Pädagogin B. Marquardt
    Date: May 3 - 6, 1982.

12. IPN Symposium in cooperation with UNESCO: Interests in Science and Technology Education (in English)
    Chairmanship: Prof. Dr. K. Frey, Dr. L. Hoffmann
    Date: April 2 - 6, 1984.

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12. IPN Seminars

Dissemination and Discussion of Research Findings

The IPN seminars have been planned as meetings for continuing and advanced training for professionals. These are also aimed at being an instrument for the dissemination of IPN work. Usually the seminars last one week. In order to include critical and supplementary components in the IPN seminars, at least two external speakers are invited to each one. Feedback and critical suggestions for work at the IPN are supplied through the participation of external specialists.

The language used at the IPN seminars is German (disregarding a very few lectures given in English).

The series of IPN seminars:

1. Das Modell von RASCH und seine Anwendung in der Unterrichtsforschung (The RASCH Model and its Application in Instructional Research), 1973.
2. Sachstrukturen im naturwissenschaftlichen Unterricht (Structures of the Subject for Education in Science), 1974.
3. Kybernetik als Strukturierungsprinzip im naturwissenschaftlichen Unterricht (Cybernetics as a Structuring Principle in Science Instruction), 1974.
4. Verfahren der Begründung und Legitimation in Curriculumentwicklung und Unterrichtsvorbereitung (Procedures of Substantiation and Legitimation in Curriculum Development and the Preparation of Instruction), 1974.
5. Multivariate und multifaktorielle lineare Methoden der Unterrichtsforschung (Multivariate and Multifactorial Linear Methods in Instructional Research), 1974.
6. Ziele schulischer Sexualerziehung (Goals of Sex Education in the School), 1975.
7. Handlungsorientierte Curriculumentwicklung — Grundlagen und Projekte (Action-Oriented Curriculum Development — Foundations and Projects), 1975.
8. Planung und Organisation von Projekten in der Schulreform (Planning and Organization of Projects for School Reform), 1975.
9. Ökologie im Unterricht allgemeinbildender Schulen (Ecology in Instruction at General Education Schools), 1975.

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10. IPN seminar in cooperation with CERI/OECD: Bedingungen und Modelle der Curriculuminnovation (Conditions and Models of Curriculum Innovation), 1975.

11. Einführung von Atommodellen im Unterricht (Introduction of Atomic Models in Instruction), 1975.

12. Sozialpsychologische Theorien und Curriculumentwicklung — Grundlagen und Projekte (Sociopsychological Theories and Curriculum Development — Foundations and Projects), 1976.

13. Grundlagenkonzepte der Wissenschaftskritik als unterrrichtsstrukturierende Momente (Fundamental Conceptions of Science Criticism as Instruction Structuring Elements), 1976.

14. Gesamtstrukturen des Biologieunterrichts (Overall Structures of Biology Education), 1977.

15. IPN Seminar in cooperation with the German Museum, Munich: Die Geschichte der Naturwissenschaften im naturwissenschaftlichen Unterricht (History of Science in Science Education), 1978.

16. Curriculumentwicklung — Erfahrungen und neue Perspektiven (Curriculum Development — Experiences and New Perspectives), 1978.

17. Didaktische Modelle in der Unterrichtsvorbereitung (Didactic Models in the Preparation of Instruction), 1979.

18. Planung von Physikunterricht (Planning Physics Instruction), 1979.

19. Veränderungsmessung zur Diagnose und Prognose von Lerneffekten (Measurement of Change for the Diagnosis and Prognosis of Learning Effects), 1979.

20. Physik-Grundkurse in der gymnasialen Oberstufe (Basic Physics Courses for Grades 11 - 13 of the Gymnasium), 1980.

21. Der Größenkalkül in Wissenschaft und Unterricht (Quantity Calculus in Science and Teaching), 1980.

22. Naturwissenschaften im Wahlpflichtunterricht (Natural Science in Electives), 1980.

23. Materialien zur Umwelterziehung (Materials for Environmental Education), 1981.

24. Mikrocomputer im Unterricht — Informationstechnik als Gegenstand und als Hilfsmittel des Lernens (Microcomputers in Instruction — Information Technology as a Subject and Supportive Tool of Learning), 1981

25. Erheben und Berücksichtigen von Schülerinteressen für den naturwissenschaftlichen Unterricht (Surveying and Considering Pupils' Interests for Science Education), 1982.

26. Alltagsvorstellungen und naturwissenschaftlicher Unterricht (Everyday Concepts and Science Education), 1982.

27. Statistische Analyse qualitativer Daten (Statistical Analysis of Qualitative Data), 1982.

28. Die Projektmethode im naturwissenschaftlichen Unterricht (The Project Method in Science Education), 1982.

29. Lebendiges Lernen im naturwissenschaftlichen Unterricht (Animated Learning in Science Education), 1983.

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13. Publications

A complete list is provided in the „IPN-Kurzbericht 18: Publikationen 1966 bis 1978 — List of Publications 1966 to 1978" (180 p.) and in "IPN-Kurzbericht 24: Publikationen 1979 bis 1981 — List of Publications 1979 to 1981" (115 p). Both these reports can be obtained free of charge from the Institute upon request.

All the publications are written in German unless otherwise stated.

The Institute publishes studies (a) in series which are published by the IPN itself, (b) in series and professional journals in which the Institute plays an active part, (c) in programs of publishing houses as well as in magazines and anthologies of publishing companies.

— The IPN research reports (the so-called „Blue Series") deal with the results of research projects and symposia. Published by the Beltz Verlag. So far 24 volumes have been published.

— The IPN Work Reports contain reviews of literature, investigative concepts and interim reports of on-going projects. Published by the IPN itself. So far 50 volumes have been published.

— IPN Reports-in-Brief contain information about the IPN and its scientific studies, summaries of extensive anthologies of reports, concepts and reviews of science-related research. Published by the IPN itself. So far 27 volumes have been published.

— In the IDK series the results of activities in the field of Information - Documentation - Cooperation (IDK) are published. It contains studies which are written especially for this particular field itself, as well as running documentations of special individual fields of science eduaction (unpublished curricula, syllabi, research and development projects, etc.). Published by the Aulis Verlag Deubner & Co. KG. So far 25 volumes have appeared.

— The series "Science Education" is meant to be an aid for the daily practice of teaching and to provide suggestions for reflecting on science education. The series is edited by a com-

mittee of educators from the Federal Republic of Germany. Published by the Aulis Verlag Deubner & Co. KG. So far 6 volumes have been published.

— The IPN also publishes books apart from its own series at various publishing houses (ca. 30 books).

— The Institute also takes an active part in the publication of the "European Journal of Science Education" (EJSE), "Studies in Educational Evaluation" (SEE), and in several German journals (e.g. "Log In", "Praxis der Naturwissenschaften", and — up to 1975 — "Der Chemieunterricht").

A series of selected works follows. For this purpose we subdivide the publications in a different manner:

— IPN Curricula
— IPN Work Reports (see the definition above)
— IPN Reports-In-Brief (see the definition above)
— Book Publications (ca. 110, not listed here)
— Magazine Articles (not listed here).

IPN Curricula

IPN Biology Curricula

A biology unit bank, whose individual instruction units are bound together in a system of "building blocks", was developed for biology instruction. The units are conceived in such a manner that they can be used in various ways. The first instruction units were published in 1974 by the Aulis - Verlag, Cologne. The topics are the following:

DER Mensch und DIE Tiere. (Man and Animals)
Instruction Unit for Grade 5; 11 - 14 Lessons, by U. KATTMANN and S. STANGE-STICH, 1974.

Die Bewegung unseres Körpers. (Body Movement)
Instruction Unit for Grade 5; 9 - 10 Lessons, by G. BITTERLING, 1974

Nahrungsmittel und Verdauung. (Food and Digestion)
Instruction Unit for Grades 5 and 6; 11 - 12 Lessons, by G. BITTERLING, B. v. BOCK und POLACH, G. MENZEL, 1974.

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Sexualität des Menschen. (Human Sexuality)
Instruction Unit for Grades 5 and 6; 11 - 14 Lessons, by [illegible]. KATTMANN, H. LUCHT and S. STANGE-STICH, 1974.

Biologisches Gleichgewicht. (Biological Equilibrium)
Instruction Unit for Grades 6 and 8; 11 - 15 Lessons, by G. EULEFELD and G. SCHAEFER, 1974.

Atmung und Blutkreislauf. (Respiration and Blood Circulation)
Instruction Unit for Grades 5 and 6; 13 Lessons, by G. MENZEL, 1976

Überwinterung. (Hibernation)
Instruction Unit for Grades 6 and 8; 14 Lessons, by E. LIPKOW, 1976.

Blätter und Verdunstung. (Foliage and Evaporation)
Instruction Unit for Grade 6; 10 Lessons, by K. SCHILKE, 1976.

Tiere sind anders. (Animals are Different from Us)
Instruction Unit for Grades 4 and 5; 8 Lessons, by K. DYLLA and G. SCHAEFER, 1977.

Thema Luft. (Subject: Air)
Instruction Unit for Grades 9 and 10; 16 Lessons, by G.G. BEGEROW, D. RODI, D. LINHART and H. SCHNEIDER, 1977.

Thema Acker. Probleme einer Monokultur. (Subject: Arable Field. Problems of a Monoculture)
Instruction Unit for Grades 7 and 8. Teacher's Manual 152 p.; 2 students' manuals: 20, 28 p.; 2 text manuals: 8, 12 p.; slides;
by G.G. BEGEROW, D. RODI, F. BAY and G.J. KRIEGLSTEINER, 1978.
The problems of the arable field as a monoculture are presented with respect to the sufficient and healthy nutrition of man from the aspects of soil and fertilization, weed control, pest control, breed of resistant grain etc.

Probleme der Wasserverschmutzung. (Problems of Water Pollution)
Instruction Unit for Cooperation between the subjects Biology/ Geography/Social Studies in Grades 9/10. Teacher's manual: 250 p.; 5 students' manuals: 38, 32, 39, 40, 40 p.;
by G. EULEFELD, D. BOLSCHO, W. BÜRGER, K.-H. HORN, 1979.
The instruction unit for circa 14 double periods in 2 cooperating disciplines encourages independent work on the part of the stu-

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dents in small groups and in plenary sessions. 5 films (4 of them in cooperation with the FWU in Munich) and a series of slides were developed.

Überwinterung. (Hibernation)
Instruction Unit for Grades 6 to 8; 180 p.; 2nd revised edition; by E. LIPKOW (revision) and K. SCHILKE (editorial cooperation), 1980.
This phenomenon is observed in vertebrates, invertebrates and in humans. While doing so, various adjustments in the different living beings to fit the seasonal changes of the environment are studied, in part via experiments (adaptation in anatomy/ morphology and behaviour, adaptibility through learning and planning).

Herbstfärbung und Laubfall. (Autumnal Colours and Defoliation)
Instruction Unit for Grades 6 and up; 122 p.; 2 nd, revised edition; by K. SCHILKE (revision), 1980.
In this instruction unit the pupils study autumnal colours and their causes. Simple separations of leaf pigments are done and the substantial basis of the leaf pigments is uncovered. The actual discarding of the leaves, the hereditary character of this phenomenon and the formation of humus from the discarded leaves are dealt with. Two groups of animals which are important for soil ecology are presented.

Schutz des Waldes. (Protection of the Forest)
Instruction Unit for a Cooperation between the Disciplines Biology, Geography, Social Studies as well as other Combinations — Depending on the Instruction Situation; Grade 7 and up; Teacher's manual 197 p., students' manual 65 p., additional texts 118 p., 14 slides; for 18 double periods; by Regula KYBURZ-GRABER, 1981.
During the problem-finding stage, investigations are conducted in the forest and concerning the forest and foresters, and the populace is interviewed. In small group work four social and three natural scientific topics are dealt with.

Basic Science Education and Electives in the Field of Science at Secondary Level I
Instruction materials from this completed project will be published in 1983 beginning with: "Unsere Haut", (Our Skin), "Integrierte Schädlingsbekämpfung" (Integrated Pest Control) and "Chroni-

sche Gesundheitsgefährdung" (Chronic Dangers to Health and How to Avoid Them).

IPN Chemistry Curricula

For *chemistry instruction in the 5th and 6th grades* of general education schools, the following instruction modules have been developed. They take information from related subjects into account. The teaching instructions contain a test booklet, answer sheet, evaluation stencil and work sheets. The curriculum covers 2 school years. The material is distributed by the IPN. The topics are:

C.1.1. Wir reinigen Wasser und gewinnen Speisesalz. (We purify water and obtain salt) 13 to 17 lessons.

C.1.2. Wir untersuchen das Entfachen von Feuer, das Verschwelen und das Verbrennen. (We investigate the kindling of fire, the smouldering and the burning of fire) 13 to 17 lessons.

C.1.3. Wir lernen beim Bau einer Hütte Stoffeigenschaften und Stoffartumwandlungen kennen und unterrichten uns über die Bekämpfung von Bränden. (While building a hut we become acquainted with the properties of matter and how matter is converted, and we learn about fire fighting) 12 to 17 lessons.

C.1.4. Wir untersuchen Kalk- und Zementmörtel. (We investigate lime and cement mortar) 10 to 17 lessons.

C.1.5. Wir machen Nahrungsmittel haltbar und untersuchen Gärungen. (We preserve food and study fermentation) 11 to 15 lessons.

C.1.6. Wir lernen, wie man Metalle herstellt und wozu man diese verwendet. (We learn how to produce metals and what they are used for) 14 to 17 lessons.

C.1.7. Wir lösen, kristallisieren, extrahieren und fällen. (We dissolve, crystallize, extract and precipitate) 13 to 16 lessons.

C.1.8. Wir stellen elektrochemische Zellen her und untersuchen an diesen Stoffart- und Energieartumwandlungen. (We produce electrochemical cells and using them we study the conversion of matter and energy) 10 to 16 lessons.

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Note: A revised version of the modules C.1.1. und C.1.2. has been published by the Klett-Verlag, Stuttgart, as parts of the "IPN-Curriculum Chemie, Unterrichtseinheiten für die Orientierungsstufe" (IPN Curriculum Chemistry, Instruction Units for the Orientation Level) under the headings "Wasser" (Water) and "Feuer" (Fire), respectively. The modules each contain a teacher's manual, a student's manual, with instructions for the experiments. Publishing began in 1980.

For *chemistry instruction in the Gymnasium* a curriculum *"Stoffe und Stoffumbildungen"* (Matter and the Conversion of Matter) is in the process of being developed which should begin in the 8th grade and provisionally end in the 10th grade. The first and the second part have been published by the Klett-Verlag, Stuttgart, since 1979, the third part will be published in 1983.

Part I with the subtitle *"Ein Weg zur Atomhypothese"* (A Path to the Concept of Atom) was published in the following parts:

a) Lehrerhandbuch (Teacher's Manual), 573 p.,
by J. WENINGER (Ed.), Helga PFUNDT (Ed.), W. DIERKS, W. MARCUS et al., 1979.
The book consists of: introduction to the course; instruction guidelines; tests; work sheets and instructions for the pupils for conducting experiments.

b) Experimentieranleitungen für Lehrer (Directions for Experimenting to the Teacher), 262 p.,
by Helga PFUNDT (Ed.), W. DIERKS (Ed.), W. MARCUS (Ed.), 1979.
Each of the experiment directions contains: a list of the necessary equipment and substances; a sketch of the experimental setup; a description of the manner of conducting the experiment; a description of the findings - with explanation.

c) Informationsbuch für Schüler (Information Booklet for Pupils), 146 p.,
by J. WENINGER (Ed.), Helga PFUNDT (Ed.), W. DIERKS, W. MARCUS, 1979.
The information booklet aims to help pupils to work on the preceding lessons and to prepare for subsequent ones. It contains a presentation of the overall train of thougths of the course.

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The topics are:

1. Einige Stoffe, die in der Natur vorkommen (Some types of matter which occur in nature). Die Verbrennung von Schwefel als Stoffumbildung (The burning of sulfur as a conversion of matter). Einige Fachwörter (Some technical terms).

2. Kalk und einige Stoffe, die sich aus Kalk herstellen lassen (Lime and matter which can be produced from it).

3. Herstellen von Metallen und Koks (The production of metal and coke).

4. Die Veraschung von Metallen und die Verhüttung von Metall-Aschen als Stoffumbildungen, an denen Sauerstoff beteiligt ist (The incineration of metals and the smelting of metal ashes as conversion of matter in which oxygen plays a part).

5. Die Folge der Sauerstoffübernehmer und die Folge der Sauerstoffübergeber (The series of substances which bind and release oxygen).

6. Stoffumbildungen als Vereinigung und Zerlegung von Stoffen (Conversion of matter as the union and decomposition of matter).

7. Die Grundstoffhypothesen (The element hypotheses).

8. Stoffgemische und zusammengesetzte Reinstoffe (Mixed substances and combined pure substances). Wäßrige Lösungen und Wasser (Watery solutions and water).

9. Stoffumbildungen sind keine Mischungs- und Entmischungsvorgänge (The conversion of matter is not a mixing and unmixing procedure).

10. Die Atomhypothesen (Atom hypotheses)

11. Die Erhärtung der Hypothese vom Aufbau der Stoffe aus Atomen (Consolidation of the hypothesis of the structuring of matter from atoms).

12. Stoffumbildungen als Umgruppierungen von Atomen (Conversion of matter as the rearrangement of atoms)

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Part 2 with the subtitle *„Von der Atomhypothese zur Kern-Elektron-Hypothese"* (From the Concept of the Atom to the Nucleus-Electron Hypothesis) is made up of the following sections:

a) Unterrichtsbeschreibung (Description of Instruction), 254 p. by W. MARCUS and H. PFUNDT, 1982.
This book consists of an introduction to the course and a description of instruction.

b) Experimentieranleitungen (Directions for Conducting Experiments),
by W. MARCUS (Ed.), H. PFUNDT (Ed.), W. DIERKS (Collaborator), 1982.

The topics are:

13. Wie läßt sich der Aufbau von Molekülen pleoatomider Gase feststellen? Die Hypothese von AVOGADRO (How can the structure of the molecules of pleoatomic gases be determined? AVOGADRO's hypothesis).
14. Erste Untersuchungen zum Aufbau der Moleküle leichtflüchtiger Stoffe (First investigations of the structure of the molecules of volatile substances).
15. Schwefligsäure, Schwefelsäure und Sulfate (Sulfurous acid, sulfuric acid and sulfates).
16. Salzsäure und Chloride (Hydrochloric acid and chlorides).
17. Salpetersäure und Nitrate (Nitric acid and nitrates).
18. Kohlenstoffsäure (Carbonic acid).
19. Untersuchungen zum Aufbau der Teilchen von Wasserstoff, Chlor, Hydrogenchlorid und einigen anderen leichtflüchtigen Stoffen (Studies of the structure of particles of hydrogen, chloride, hydrogen chloride and some other volatile substances).
20. Untersuchungen zum Aufbau der Moleküle von gasigem Schwefeloxid, von nichtbrennbarem und von brennbarem Kohlenstoffoxid (Studies of the structure of the molecules of gaseous sulphur oxide, of noncombustible and of combustible carbon oxide).
21. Die Fällungsmittelfolge (The series of precipitants).
22. Die Untersuchungen von GALVANI und VOLTA (The studies of GALVANI and VOLTA).

23. Einige Grunderscheinungen und Grundbegriffe aus dem Bereich elektrischer Vorgänge (Some fundamental phenomena and concepts from the field of electrical processes).

24. Die Folge der Minuspolbildner und die Hypothese, daß Stoffumbildungen und elektrische Vorgänge eng miteinander zusammenhängen (The series of substances with the property to form a negative pole and the hypothesis that conversions of matter and electrical processes are closely connected).

25. Stoffumbildungen in galvanischen Zellen (Conversions of matter in galvanic cells).

26. Die Hypothese, daß bei Stoffumbildungen in galvanischen Zellen Elektrizität zwischen Metallatomen verschiedener Art übergeht. Ionen (The hypothesis that in the course of the conversion of matter in galvanic cells electricity passes between metal atoms of various kinds. Ions.).

27. Die Hypothese, daß positive Metallionen entstehen, indem ungeladene Metallatome negative Elektrizität abgegeben (The hypothesis that positive metal ions are formed when uncharged metal atoms give off negative electricity).

28. Metallatome sind zusammengesetzte Teilchen (Metal atoms are composite particles).

29. Elektronenübergänge bei bestimmten Stoffumbildungen und die Folge der Elektronenübergeber (Transfer of electrons during certain conversions of matter and the series of electron surrenderers).

30. Die Hypothese, daß am Aufbau der Atome vieler Metalle mehr als ein Elektron beteiligt ist (The hypothesis that more than on electron is involved in the structure of the atoms of many metals).

31. Die Hypothese, daß auch Nichtmetallatome aus einem positiv elektrisch geladenen Bestandteil und Elektronen aufgebaut sind (The hypothesis that nonmetal atoms are also composed of one positively electrically charged component and electrons).

32. Die Kern-Elektron-Hypothese und die Vorstellungen vom Stoffaufbau und von den Stoffumbildungen (The nucleus-electron hypothesis and the conceptions of the structure of substances and conversions of matter).

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Part 3 with the subtitle *„Die Blickwende vom Einzelteilchen zum Teilchenaggregat"* (Shifting the Attention from Single Particles to Particle Aggregates) will be published in 1983.

IPN Physics Curricula

A curriculum for grades 5 to 10 has been developed by which physics for this level may be covered. The units of the curriculum, however, can also be used independent of the curriculum (Unit Bank Concept). All instruction units and a teacher's manual are available in a revised version for grades 5 and 6. The revision is based on experiences with a test version. The teaching materials include teacher's guide, pupil's manual and tests. The units have been published by the Klett-Verlag, Stuttgart.

OS 1 Der elektrische Stromkreis (The Electric Circuit). Responsible for the current version: R. DUIT, H. NIEDDERER, 1974.

OS 2 Arbeit und Energie (Work and Energy). Responsible for the current version: W. WESTPHAL, H. DAHNCKE, 1975.

OS 3 Ausdehnung bei Erwärmung — Temperaturmessung — Wärmeausbreitung (Expansion on Heating - Temperature Measurement - Heat Transfer). Responsible for the current version: R. DUIT, K. RIQUARTS, 1975.

OS 4 Länge - Zeit - Geschwindigkeit (Length - Time - Velocity). Responsible for the current version: Chr. v. RHÖNECK, 1975.

OS 5 Magnetismus (Magnetism). Responsible for the current version: P. HÖLCK, R. DUIT, 1975.

OS 6 Licht und Schatten (Light and Shadow). Responsible for the current version: G. LIND, 1975.

OS 7 Kräfte (Forces). Responsible for the current version: R. DUIT, P. HÖLCK, K. RIQUARTS, W. WESTPHAL, 1975.

OS 8 Fotografie (Photography). Responsible for the current version: G. LIND, P. HÖLCK, 1978.

A revision of the instruction units previously available in a test version has been begun for grades 7 and 8. A first unit is available: „Energie, Arbeit, Leistung, Kraft" (Energy, Work, Power, Force). Responsible for the current version: R. DUIT, H.D. v. ZIELEWSKI, 1978.

Until the publication of further revised units, test versions are available on the following topics:

7.4. Stromstärke und Widerstand (Electric Current and Resistance).

7.5. Druck in Flüssigkeiten und Gasen (Pressure in Liquids and gases).

8.1. Elektrische Spannungen (Voltage).

8.2. Wechselstrom (Alternating Current).

8.3. Elektrizitätswirtschaft (Economy of Electrical Energy).

8.4. Steuerung und Regelung (Feedback and Control).

For the 9th and 10th grades two manuals and five units have been published:

Lehrerbegleitheft zum IPN Curriculum Physik für das 9. und 10. Schuljahr (Teacher's manual for the IPN physics curriculum for the 9th and 10th grades). Responsible for the current version: R. LAUTERBACH, 1975.

Anleitungen zur Gruppenarbeit. IPN Curriculum Physik für das 9. und 10. Schuljahr (Instruction for group work. IPN physics curriculum for the 9th and 10th grades), W. BÜRGER, 1975.

9.1. Modelle des elektrischen Stromkreises (Models of the Electric Circuit), E. KIRCHER, 1975.

9.2. Elektronik (Electronics), H. NIEDDERER, J. WILMS, H.D.v. ZIELEWSKI, 1975.

9.3. Energieversorgung durch Kernkraftwerke (Energy Supply by Nuclear Power Plants), 228 p., H. MIKELSKIS, R. LAUTERBACH, 2nd revised edition, 1980.
While maintaining the original educational concept of the instruction unit, actualizations and thematic expansions (nuclear re-processing, reactor security, radiobiological questions) are taken up.

10.1. Energie quantitativ: Benzin- oder Elektroauto (Energy Quantitatively: Electro or Gasoline Car), K. MIE, J. WALTER, H. HÄRTEL, 1976.

10.2. Steuerung und Automation (Control and Automation), H. HÄRTEL in cooperation with K. JÄCKEL, J. LEHMANN, 1976.

An alternative presentation of the contents of instruction units 7.4. and 9.1. is contained in:
Der elektrische Stromkreis als System (The Electrical Circuit as a System), Educational guidelines and 2 pupil's manuals, 251 p., by H. HÄRTEL, 1980.
In contrast to traditional instruction, the topic is seen here in a new light: the aspect of a system of the electrical circuit is brought to the fore and serves as a basis for subsequent concepts and laws.

The topic "energy" (see instruction units 9.3. and 10.1) is taken up again in:
Alternative Energiequellen — Themenheft 6 (Alternative Sources of Energy — Topic Booklet 6), Naturwissenschaften im Unterricht - Physik/Chemie, Vol. 29, issue 8, 1981, 64 p.; Aulis Verlag, Köln (Note: a different publisher. All the other material on physics instruction has been published by the Klett Verlag, as mentioned above);
by. H. MIKELSKIS (Ed.).
The booklet includes the following contributions (in German): The significance of regenerative energy sources for energy supply and the treatment of this topic in physics and chemistry instruction (H. MIKELSKIS); Use of solar energy as source of heating. An instruction unit (K.E. STILLE); Hot water from the sun (R. BORSCH); Use of wind energy (R. BORSCH, L. HORNUNG, J. KLING, L. SCHÖBINGER); Construction of a Darrieus-Rotor model for use of wind energy (D. SCHMARBECK); Energy from the environment (D. BOHNENKAMP); Hydrogen technology (F. HEIDORN, K. MIE); Energy from bio-mass (H. MÖRNINGHOFF); Saving energy as a source of energy (U. ZIMMERMANN).

Science Instruction for Handicapped Children

The IPN has begun, in cooperation with the Teachers College of Kiel (Department of the Education of the Handicapped) to adapt an American curriculum for handicapped children:
"AKTIF - Alle Können Teilhaben an Ideen und Fertigkeiten" (All Can Participate in Ideas and Skills). AKTIF is an adaptation of SAVI (Science Activities for the Visually Impaired) that was developed at the University of California, Berkeley (USA). The adapted materials are meant for use in elementary and special schools.

IPN Work Reports

The series "IPN Work Reports" is published by the IPN itself in order to inform a larger circle of interested persons about studies, literature reports, investigative concepts and provisional results of current projects. The IPN Work Reports appear irregularly and can be obtained from the IPN under a cover charge of DM 14,50.

The following have already appeared (or will appear):

1 HOFFMANN, L., KATTMANN, U., LUCHT, H., SPADA, H., STICH, S.:
Die Wirkung einstellungsverändernder Maßnahmen im naturwissenschaftlichen Unterricht auf das Verhalten von Schülern im Problemfeld Technik, Energie und Umweltschutz: Theoretische Grundlagen und Versuchsplanung. (The Effect of Attitude-Changing Measures in Science Education on the Behavior of Pupils in the Fields of Technology, Energy and Environmental Protection: Theoretical Foundations and Experiment Planning) 217 p., 1973 — out of print —.

2 NIEDDERER, H.:
Untersuchung von Schülerfähigkeiten durch Analyse physikalischer Sachstrukturen und Anwendung eines probabilistischen Testmodells. (The Investigation of Pupil Abilities by Means of the Analysis of Physics Structures and the Use of a Probabilistic Test Model) (72 p., 1973) — out of print —.

3 LYBECK, L.:
Konzepte zum fächerübergreifenden naturwissenschaftlichen Unterricht. (Concepts on Interdisciplinary Science Education) 118 p., 1973, — out of print —.

4 DUIT, R.:
Über langzeitliches Behalten von Verhaltensdispositionen in einem physikalischen Spiralcurriculum. (On Long-Term Retention of Behavior Dispositions in a Physics Spiral Curriculum) 173 p., 1973, — out of print —.

5 SPADA, H., HÄUSSLER, P., HEYNER, W.:
Denkoperationen und Lernprozesse als Grundlage für lernerorientierten Unterricht: Versuchsplanung und erste Ergebnisse. (Cognitive Operations and Learning Processes as a Basis for Learner-Oriented Instruction: Experiment Planning and First Findings) 343 p., 1973 — out of print —.

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6 LEHMANN, J., LEHRKE, M., LIND, G.:
Grundlagen einer Technologie intrinsisch motivierten Lernens. Band 1 (Foundations of a Technology of Intrinsically-Motivated Learning. Vol. 1) 264 p., 1973, — out of print —.

7 AUFSCHNAITER, St., v.:
Die Bedeutung von Taxonomien für die Entwicklung eines Physikcurriculums. (The Relevance of Taxonomies for the Development of a Physics Curriculum) 128 p., 1973 — out of print —.

8 LANG, M.:
Zur Messung der von Schülern erfaßten Bedeutung naturwissenschaftlicher Termini. (On the Measurement of the Pupils' Comprehension of the Meaning of Scientific Technical Terms) 75 p., 1973 — out of print —.

9 DAHNCKE, H.:
Energieerhaltung in der Vorstellung 10- bis 15-jähriger. (The 10 to 15-Year Old's Idea of the Preservation of Energy). 117 p., 1973 — out of print —.

10 KEMPF, W.F.:
Drei Arbeiten über verallgemeinerte Rasch-Modelle (Three Papers on Generalized Rasch Models) (in German and in English) 57 p., 1974 — out of print —.

11 STAECK, L.:
Synopse der Richtlinien und Lehrpläne für Biologie der Länder der Bundesrepublik und West-Berlins. Eine Bestandsaufnahme des Biologieunterrichts. (A Synopsis of the Guidelines and Syllabi of the Federal Republic of Germany and West Berlin. Taking Stock of Biology Instruction) 259 p., 1974 — out of print —.

12 MASSEN, B.:
Unterrichtsmaterialien zum Bereich Ökologie — Umweltschutz. Eine annotierte Bibliographie. (Teaching Material on Ecology - Environmental Protection. An Annotated Bibliography) 227 p., 1975 — out of print —.

13 KEMPF, W.F., HAMPAPA, P., MACH, G.:
Conditional Maximum Likelihood Estimation for a Dynamic Test Model. (In English) 75 p., 1975 — out of print —.

14 HOFFMANN, L., LEHRKE, M.:
Formalisierte Theorien des Denkens und Lernens und ihre Anwendung im naturwissenschaftlichen Unterricht. Kurzfassungen der Referate des 7. IPN-Symposions. (Formalized Theories of Thinking and Learning and their Application in Science Instruction. Shortened Version of the Reports from the 7th IPN Symposium) 125 p., 1975 — out of print —.

15 HOFFMANN, L., KATTMANN, U., LUCHT, H., SPADA, H.:
Materialien zum Unterrichtsversuch: Kernkraftwerke in der Einstellung von Jugendlichen. (Materials for the Classroom Experiment: Nuclear Power Plants in the Opinion of Adolescents) 460 p., 1975 — out of print —.

16 KATTMANN, U.:
Sexualerziehung in der Schule. Richtlinien — Lernziele — Lehrerbildung. (Sex Education in the School. Guidelines — Goals — Teacher Training) 197 p., 1975 — out of print —.

17 GEISER, H., HÄUSSLER, P.:
Naturwissenschaften im Unterricht der Orientierungsstufe — Entwürfe und Materialien für Lernen im Medienverbund (The Sciences in the Instruction of the "Orientierungsstufe" — Drafts and Materials for Learning with combined Media) 173 p., 1975 — out of print —.

18 BAYRHUBER, H., SCHAEFFER, G.:
Kybernetische Biologie — Unterrichtseinheit für die Studienstufe (Cybernetic Biology — Instruction Unit for the "Studienstufe"). 352 p., 1977 — out of print —.

19 BLOCH, J.R., LANG, M., KÜNZLI, R.:
Studien zur kommunikativen Kompetenz und ihre Bedeutung für eine Didaktik der Naturwissenschaften. (Studies on Communicative Competence and its Significance for Science Education) 190 p., 1977.

20 IMBERG, K., MAY, R.:
Unterrichtsmaterialien zum Integrierten Curriculum Naturwissenschaft - Bestandaufnahme und Analyse (Teaching Material for the Integrated Science Curriculum - Stock-Taking and Analysis) 250 p., 1976 — out of print —.

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21 MINSSEN, M., WALGENBACH, W.:
Didaktische Materialien für die Planung naturwissenschaftlicher Kurse auf der Sekundarstufe II. Entwicklung naturwissenschaftlichen Wissens am Beispiel des Makromolekülkonzepts. (Didactic Materials for the Planning of Science Courses for "Sekundarstufe II". Development of Scientific Knowledge Using the Macromolecular Concept as an Example) 380 p., 1977 — out of print —.

22 KEMPF, W.F., NIEHUSEN, B., MACH, G.:
Logistische Testmodelle mit additiven Nebenbedingungen (Logistic Test Models with Additive Side Effects) 140 p., 1976 — out of print —.

23 NIEHUSEN, B., HANSEN, H., KEMPF, W.F., MACH, G., ROST, J.:
Manual der IPN-Programmbibliothek. Band 1 (IPN Program Library Manual. Vol. 1) 256 p., 1978.

24 NIEHUSEN, B., HANSEN, H., KEMPF, W.F., MACH, G., ROST, J.:
Manual der IPN-Programmbibliothek. Band 2 (IPN Program Library Manual. Vol. 2) 355 p., 1978.

25 ENTRICH, H.:
Lehrerbildung Biologie (Teacher Training in Biology) 436 p., 1976.

26 ROST, J.:
Diagnostik des Lernzuwachses — Ein Beitrag zur Theorie und Methodik von Lerntests. (Diagnosis of Learning Increase — A Contribution to the Theory and Method of Learning Tests) 109 p., 1977, — out of print —.

27 ASTOLFI, J.P., COULIBALY, A., HOST, V.:
Ein lernzielorientierter Biologielehrplan für die Klassen 5 und 6. Translation from French: Annette SCHWERDTFEGER. (A. Learning Objective-Oriented Biology Syllabus for Grades 5 and 6) 124 p., 1977.

28 SPADA-SCHWEIZER, V.:
Ein experimentelles Simulationsspiel zur Umwelterziehung — Theorie und Anwendung eines Nicht-Nullsummenspiels. (An Experimental Simulation Game on Environmental Education — Theory and Applications of a Non-Zero Sum Game) 245 p., 1977.

29 BLOCH, J.R., KÜNZLI, R., LANG, M. (Hrsg.):
Grundlagenkonzepte der Wissenschaftskritik als unterrichtsstrukturierende Momente. Referate des 13. IPN-Seminars. (Basic Concepts of Science Criticism as Instruction-Structuring Moments. Papers from IPN Seminar 13) 371 p., 1978 — out of print —.

30 BLOCH, J.A.:
To a Model for the Adaptation of Curriculum Materials and its Use in the Work with "Individualized Science" in West Germany (in English) 262 p., 1978.

31 MARQUARDT, B., LAUTERBACH, R., (Hrsg.):
Der Lehrplan (1975 - 1977) zum Sachunterricht in Schleswig-Holstein - Erfahrungsberichte, Kritiken und Revisionsempfehlungen. (The General Science Syllabus (1975 - 1977) in Schleswig-Holstein — Reports on Experiences, Critique and Recommendations for Revisions) 170 p., 1978 — out of print —.

32 SKOTNICKY, J.:
Grundlagen der chemischen Thermodynamik (Fundamentals of Chemical Thermodynamics) 180 p., 1978

33 BLUM, A.:
Water Pollution in Environmental Education Curricula — A Comparative Study (in English) 127 p., 1978.

34 BÜNDER, W., NENTWIG, P., in cooperation with BLOCH, June A., BOSLER, U., GEISER, H., ISENSEE, W., KIRCHER, E., LAUTERBACH, R.:
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The "IPN-Kurzberichte" ("IPN Reports-in-Brief") contain information about the IPN and its scientific studies, summaries of extensive anthologies of reports, concepts and reviews of science-related research. They appear irregularly and are available at present without charge from the Institute. Address requests to the IPN, Olshausenstrasse 40 - 60, D - 2300 Kiel 1.

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14. The Members of the Boards

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Head of the Department "Universities and Science" at the Educational Ministry of Schleswig-Holstein, Kiel.

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Educational Ministry of Hessen, Wiesbaden.

Professor Dr. Thomas Kruck
Institute for Anorganic Chemistry at the University of Cologne.

Note: In accordance with the statutes, Ministerialrat Karl Ludwig has been succeeded by Ministerialrat Winfried Hosseus, Mainz.

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Professor Walter Jung
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Institute for Anorganic Chemistry at the University of Cologne.

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Professor Dr. Gerhard Priesemann
Institute of Education, Christian Albrecht University, Kiel.

Professor Dr. Horst Ruprecht
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Professor Dr. Eberhard Todt
Psychology Department at the University of Gießen.

Professor Dr. Horst Werner
Institute for Science Teaching at the University of Salzburg (Austria).

Note:
In accordance with the statutes, three representatives from the Laender have left and have been replaced by representatives from other Laender. The following are no longer members: Ministerialrat Karl Ludwig, Ministerialrat Dr. Wilhelm Mügel, and Regierungsdirektor Jan Stroman. The replacements are: Oberstudienrat Werner Liessel (Educational Ministry of Bayern, München), Ministerialdirigent Dr. Erwin Saar (Educational Ministry of the Saarland, Saarbrücken), and Oberschulrat Günter Ziebegk (Educational Ministry of Berlin).

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15. The Staff Members of the IPN and their Main Working Areas

This list includes people employed at the IPN in January 1983. About 150 teachers and 30 scientists as well as representatives from other fields also cooperate with the IPN semi-officially.

BLÄNSDORF, Klaus	Dr. rer. nat. Dipl.-Physiker	Integrated Science Curriculum, Coordinator of IPN Symposia and Seminars
BLOCH, Jan Robert	Dr. phil. Dipl.-Chemiker	Science Education, Curriculum Research, Theory of Science
BOSLER, Ulrich	Dr.-Ing. Dipl.-Ing.	Computer Science and its Connection with Science Education, Teacher Training
BÜNDER, Wolfgang	Dr. rer. nat. Dipl.-Chemiker	Chemistry Education, Teacher Training, University Education
DIERKS, Werner	Studiendirektor	Chemistry Education
DUIT, Reinders	Dr. rer. nat. Wiss. Oberrat	Physics Education, Curriculum Development and Evaluation
EULEFELD, Günter	Studiendirektor	Biology Education, Ecology and Environmental Education
FREY, Karl	Prof. Dr. phil. Dipl.-Psychologe	Basic Questions of Science Education, Guidance of the IPN
GEISER, Helmut	Dipl.-Pädagoge	General Education, Media Education
HÄRTEL, Hermann	Dr. rer. nat. Dipl.-Physiker	Physics Education, Curriculum Development

HÄUSSLER, Peter	Privatdozent Dr. rer. nat. Dipl.-Physiker Wiss. Direktor	Physics Education
HAMEYER, Uwe	Dr. phil. Dipl.-Pädagoge Wiss. Oberrat	Curriculum Theory, Education, Innovation Research
HANSEN, Klaus-Henning	Dipl.-Soziologe	Evaluation, Methods of Empirical Social Research; Informatics
HECHT, Karl	Prof. Dr. phil. Emeritus, First Director of IPN	Physics Education, Scientific and Technical Training of Adults
HOFFMANN, Lore	Dr. phil.	Cognitive and Learning Psychology, Educational and Psychological Methodology
JÜDES, Ulrich	Dr. rer. nat. Hochschulassistent	Biology Education
KAPUNE, Thorsten	Dr. rer. nat. Wiss. Direktor	Science Management at the IPN
KÜNZLI, Rudolf	Dr. phil. Wiss. Direktor	General Education, Education Philosophy
LANG, Manfred	Dr. phil. M. Sc. Dipl.-Psychologe	Cognitive Psychology, Communication in Instruction
LANGEHEINE, Rolf	Dr. paed. Dipl.-Psychologe	Social Psychology, Psychological Methodology
LAUTERBACH Roland	Dr. phil. M.A., Grund- und Hauptschullehrer	Science Education, Curriculum Development and Implementation, General Science
LEHMANN, Jürgen	Dr. phil. Dipl.-Soziologe	Instruction Methodology, Educational Psychology

LEHRKE, Manfred	Dipl.-Psychologe	Motivational and Learning Psychology, Instructional Research
LIND, Gunter	Dr. rer. nat. Wiss. Oberrat	Physics Education, Motivational Psychology, Theory of Science
MARQUARDT, Brunhilde	Dipl.-Pädagogin Lehrerin	Biology Educatio ., General Science
MIE, Klaus	Dr. rer. nat. Dipl.-Physiker	Curriculum Development, Physics Education
MIKELSKIS, Helmut	Dr. rer. nat. Dipl.-Physiker	Physics Education, Curriculum Development
MINSSEN, Mins	Dr. rer. nat. Dipl.-Chemiker	Science Education, Teacher Training
NENTWIG, Peter	Dipl.-Chemiker	Chemistry Education
PFUNDT, Helga	Oberstudienrätin	C emistry Education, Curriculum Development
RIMMELE, Rolf	Dipl.-Psychologe	Learning and Retention Process, Methodology
RIQUARTS, Kurt-Gerhard	Dr. phil.	Curriculum Evaluation, Analysis and Documentation of Curriculum Materials
ROST, Jürgen	Dr. rer. nat. Dipl.-Psychologe Wiss. Rat	Test Theory, Psychology of Memory and Methodology
SCHILKE, Karl	Dr. rer. nat.	Biology Education, Curriculum Development (Ecology)
SCHULZ-ZANDER, Renate	Wissenschafliche Angestellte	Computer Science

SKAUMAL, Ulrike	Dr. rer. nat.	Biology Education, Analysis and Documentation of Curriculum Materials
WALDOW, Hans-Jürgen	Dipl.-Informatiker	Computer Science, Analysis and Documentation of Curriculum Materials
WALGENBACH, Wilhelm	Dr. phil. Hauptschullehrer Wiss. Rat	General Education, Curriculum Research, Teacher Education and In-Service Training
WENINGER, Johann	Oberstudiendirektor, Head of the Dept. of Chemistry Education until 1982; retired	Chemistry Education, Foundation of Science Education, Theory of Science
WESTPHAL, Walter	Prof. Dr. rer. nat. Dipl.-Physiker	Physics Education
WOLZE, Wilhelm	Dr. phil. Ing. (grad) Hochschulassistent	Physics Education, Theory of Science
ZACHARIAS, Frank	Dr. rer. nat. habil.	Biology Education (Ecology)
ZIEFUSS, Horst	Dr. phil., Ing. (grad.) Realschullehrer	Occupational Orientation in Science Education

Affiliated Members of the Staff

BOWYER, Jane	Fulbright Research Professor (from Berkeley, California, USA)	Science Education
FICHERA, Annamaria	Scholarship Student (from Rome, Italy)	Physics Education, Special Theory of Relativity
HAFT, Henning	Prof. Dr.päd., Pädagogische Hochschule Kiel	General Education, Curriculum Research and Documentation
JENELTEN-ALLKOFER, Christel	Dr. rer. nat.	Educational Psychology, French Translations
MALLIOU, Kleoniki	Scholarship Student (from Athens, Greece)	General Education, Science Education, Curriculum Research
NELLEN, Uta	Diplom-Biologin	Biology Education, Development of Teaching Materials
RIOSECO, Maria de la Luz	Lecturer (from Santiago de Chile)	Education of Physics Teachers, Interests in Science Education

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The institute is made up of the following departments: Biology Education, Chemistry Education, Physics Education, Educational Science, Research Methodology and Statistics, and Administration and General Services.

Apart from individual books, the IPN also publishes the results of research projects and symposia through the Beltz Publishing Company. The IPN Work Reports contain reviews on literature, investigative concepts and provisional results of current projects. Selected reports, essays and papers from various journals and publications are presented in the IPN offprints. IPN Reports-in-Brief contain information on the IPN and its scientific studies, summaries of extensive reports, concepts and reviews of research pertaining to the sciences.